

Chapter 19

The Shrew Tenrecs (*Microgale*) (Insectivora: Tenrecidae) of the Réserve Naturelle Intégrale d'Andringitra, Madagascar

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Abstract

A collection of *Microgale* species made in humid forest between 720 and 1625 m elevation on the eastern slopes of the Réserve Naturelle Intégrale d'Andringitra in late 1993 is reviewed. The material contains a total of 10 taxa, including two previously unknown species, one of which is described; two species that were known only from the type locality (*M. parvula* and *M. soricoides*); and three taxa (*M. cowani*, *M. taiva*, and *M. melanorrhachis*) for which the new material allows redefinition of diagnostic characters. We formally remove *M. taiva* and *M. melanorrhachis* from synonymy with *M. cowani* but provisionally synonymize *M. pulla* with *M. parvula*. Information is presented on external and craniodental morphology, measurements, variation, and reproduction.

Résumé

La collection d'espèces de *Microgale* effectuée dans la forêt humide entre 720 m et 1625 m d'altitude sur le versant est de la Réserve Naturelle Intégrale d'Andringitra effectuée à la fin de l'année 1993 fait l'objet d'une discussion.

Le matériel échantillonné comprend un total de dix taxons, y compris: deux espèces encore inconnues auparavant, dont une est décrite ci-dessous et deux espèces qui ne sont connues que localement (*M. parvula* et *M. soricoides*) et enfin trois espèces (*M. cowani*, *M. taiva*, et *M. melanorrhachis*), pour lesquelles les nouveaux échantillons permettant une redéfinition des caractères utilisés pour l'identification des espèces.

Nous avons abandonné la synonymie de *M. taiva* et *M. melanorrhachis* avec *M. cowani*, mais avons donné *M. pulla* et *M. parvula* comme synonymes. Des informations relatives à la morphologie externe et craniodentaire, aux mesures biométriques, à leurs variations et à la reproduction sont présentées.

Introduction

The insectivores of Madagascar are composed of two families: (1) the Soricidae, including two species, *Suncus murinus* (Linnaeus, 1766), com-

monly occurring as a commensal with humans and almost certainly introduced (Hutterer & Tranter, 1990), and *Suncus madagascariensis* (Coquerel, 1848); and (2) the Tenrecidae. With the

exception of the subfamily Potamogalinae, the other three subfamilies of Tenrecidae are endemic to Madagascar. The degree of morphological variation within the Tenrecidae is absolutely remarkable, including the spiny "hedgehog"-like genera *Echinops* Martin, 1838, *Hemicentetes* Mivart, 1871, *Setifer* Friepe, 1806, and *Tenrec* Lacépède, 1799; the aquatic genus *Limnogale* Major, 1896a; the semi-fossorial *Oryzorictes* A. Grandidier, 1870; and the shrew-like *Microgale* Thomas, 1882, and *Geogale* Milne Edwards & A. Grandidier, 1872. Although there is no explicit phylogeny for the group, it is assumed to be monophyletic and represents one of the more spectacular adaptive radiations of mammals in the world.

The largest genus of Malagasy Tenrecidae is *Microgale* (shrew tenrecs), which has been revised by MacPhee (1987). He listed 22 validly published and available names but drastically reduced the number of recognized species to 10; furthermore, he grouped these species into phenetic clusters as follows:

cowani cluster: *M. cowani*, *M. thomasi*, *M. parvula*

gracilis cluster: *M. gracilis*

longicaudata cluster: *M. longicaudata*, *M. principula*

pusilla cluster: *M. pusilla*

brevicaudata cluster: *M. brevicaudata*

dobsoni cluster: *M. dobsoni*, *M. talazaci*

More recently, three new species have been described, one of which, *Microgale pulla* Jenkins, 1988, is here provisionally synonymized with *M. parvula* G. Grandidier, 1934. The other two species present greater problems: *M. dryas* Jenkins, 1992, groups with both the *cowani* and *gracilis* clusters, whereas *M. soricoides* Jenkins, 1993, appears to warrant a distinct cluster.

MacPhee's (1987) major revision was based primarily on dental morphology providing the framework for ontogenetic studies associated with tooth eruption patterns and measures of morphological variation within and between various species groups. Metric data on the cranium and body, and external features, were accorded somewhat less consideration. In a few cases, the limits of several "species" are poorly defined, and new specimen material is necessary to work out these taxonomic problems. This bias away from external features has in some cases caused subsequent field-workers, often dealing with live animals, to continue to use the nomenclature of Eisenberg and Gould (1970), employing a combination of

ratios of external measurements to divide the genus into four behavioral classes, and that of Genest and Petter (1975), whose key primarily employed external features. In particular, several of the nominal species synonymized under *Microgale cowani* by MacPhee have continued to appear as distinct species in the subsequent literature, including *M. taiva* Major 1896b and *M. melanorrhachis* Morrison-Scott, 1948 (see Nicoll & Rathbun, 1990; Stephenson, 1995).

In the past few years, several reports (Nicoll & Rathbun, 1990; Raxworthy & Nussbaum, 1994; Stephenson, 1995) have been made of specimens that were identified in the field, on the basis of external appearance and variations in general behavior, as "*M. cowani*", "*M. taiva*", and "*M. melanorrhachis*", all synonyms of *M. cowani* sensu MacPhee (1987). MacPhee maintained that dental evidence supported the view that the holotypes of *M. melanorrhachis* and *M. taiva* are juveniles of *M. cowani*. Among recent collections made for the University of Michigan Museum of Zoology by C.J.R. at Montagne d'Ambre, Mantady, and Ambatovaky, and for the Field Museum by S.M.G. and C.J.R., all three of the field-identified taxa include adult specimens. On the basis of this new material, some redefinition of *M. cowani* sensu MacPhee is now feasible.

First, all of these species appear to be closely related and show only slight, if any, dental variation. Second, in most cases, diagnosis is dependent on a combination of a few, mainly external, characters. Finally, several of the taxa redefined here occur sympatrically, with no evidence of intermediate specimens. Additional collections are needed to clarify several points. Also, biochemical analysis of tissues already collected may provide additional insight into the relationships of this complicated genus.

Herein we report on one of these recent collections, made during a small mammal survey undertaken by two of us (S.M.G. and C.J.R.) on the eastern slopes of the Réserve Naturelle Intégrale (RNI) d'Andringitra during November and December 1993. The regions surveyed proved highly speciose for shrew tenrecs of the genus *Microgale*. Some of these are common and their presence is predictable from their widespread occurrence in other areas of Madagascar; a few others are believed to be rare; and two are apparently undescribed. Many of the shrew tenrecs in the sample were identified from external features, but a considerable proportion were not immediately identifiable and were eventually sent to the Nat-

ural History Museum (BM(NH)) for comparative identification by P.D.J.

In this paper we review the species limits of the *Microgale* obtained in this survey. In Chapter 20 the ecology and elevational distribution of *Microgale* and other insectivores found within the reserve are discussed.

Previous Work

The only previous work conducted on the insectivores of the RNI d'Andringitra was in late 1970 and early 1971 during an expedition to the area (Paulian et al., 1971; see Chapter 1, pp. 4–5 for details). Some information on this collection, made by R. Albignac and A. Peyrieras, was presented by Genest and Petter (1975). MacPhee (1987) made reference to these species in his systematic revision of the genus *Microgale*, and in a few cases he provided new specific identifications. The expedition participants concentrated their efforts in the higher elevation zones, and most if not all of their trapping effort was with rodent traps (R. Albignac, pers. comm.). The collection of Albignac and Peyrieras is in the Muséum National d'Histoire Naturelle (MNHN), Paris. A list of the known mammal fauna of the RNA d'Andringitra was compiled by Nicoll and Langrand (1989), based on a review of the literature and their own unpublished records. The only other known collections of *Microgale* made in the reserve were in 1993 during a Cambridge University student expedition (O'Keefe & Ashmore, 1994) for eventual return to Parc Botanique et Zoologique de Tsimbazaza, Madagascar.

Materials and Methods

Trap Lines

The principal means of capturing insectivores was with pitfall buckets and drift fence; a few were obtained with standard mammal live traps. See Chapters 17 and 20 for more details on the trapping techniques.

Specimens and Measurements

Captured animals were prepared as standard museum skins with associated skulls and skele-

tons, fluid-preserved carcasses, or full skeletons. Many tissue samples were frozen in liquid nitrogen for biochemical studies, and the viscera were preserved in alcohol for endoparasite research. Whole carcasses preserved in formalin were wrapped in fine cheesecloth before immersion to prevent mixing of ectoparasites (see Chapter 12). A representative collection of the taxa described herein will be returned to the Département de Biologie Animale, Université d'Antananarivo.

Cranial measurements, in millimeters, were taken using dial calipers and a microscope measuring stage. The dental nomenclature follows that of Mills (1966), Swindler (1976), Butler and Greenwood (1979), and MacPhee (1987). Dental notations are given in parentheses in the text; premaxillary and maxillary teeth are noted by upper case letters and mandibular teeth by lower case letters. The following measurements were made from specimens in the flesh or prepared crania. Abbreviations and definitions for these measurements (all in millimeters, with the exception of weight [WT], in grams) follow.

BB (breadth of braincase): the greatest distance measured across the squamosals.

BL (braincase length): from the superior articular facet to the occipital condyle, parallel to the long axis of the skull.

CIL (condyloincisive length): cranial length from first upper incisor to occipital condyle.

EL (ear length): measured from the notch at the base of the ear to the distalmost edge of the pinna.

HB (head and body length): measured from the tip of the nose to the distalmost point of the body (at base of tail).

HF (hind foot length): measured from the back edge of the heel to the tip of the longest toe (not including claw).

I1-P3 (length of anterior upper teeth): from anterior of first upper incisor to anterior of second upper premolar.

TL (tail length): measured from the base of the tail (at right angles to the body) to the end of the distalmost vertebra. Does not include terminal hair tufts.

TOTL (total length of body and tail): measured from the tip of the nose to the end of the distalmost tail vertebra (does not include any terminal tail hair tufts). Animal is positioned on its back straight with vertebrae parallel to rule, but not stretched out.

UTL (upper tooththrow length): from anterior of

first upper incisor to posterior of third upper molar, parallel to the long axis of the skull.

WT (weight): measured with Pesola spring scales. Animals weighing less than 10 g were weighed within 0.2 g; those weighing between 10 and 100 g were weighed within 0.5 g.

Reproductive condition was recorded for males as length \times width of the testes and degree of convolution of the epididymis. Females were noted as nonperforate or perforate, nonparous or parous, and the numbers and locations of any embryos and placental scars were recorded. The mammary formula is presented as the number of paired axillary, abdominal, or inguinal teats.

The following age classes are recognized:

Infant: individuals in which the deciduous antemolar dentition and the molars are not fully erupted; premaxillary, parietal, and basioccipital sutures are unfused.

Juvenile: individuals in which the molars are fully erupted and the deciduous antemolar dentition is erupted and in the process of replacement by the permanent teeth; cranial sutures are in the process of fusing. The eruption sequence of the permanent teeth has been subdivided into four stages by MacPhee (1987); these stages have been accepted in this text, unless otherwise stated.

Adult: individuals with a fully erupted permanent dentition; cranial sutures generally fused, although their position is more or less clearly marked.

Other Abbreviations

BM(NH): The Natural History Museum, London (formerly British Museum [Natural History]).

FMNH: The Field Museum, Chicago.

MCZ: Museum of Comparative Zoology, Harvard.

MNH: Muséum National d'Histoire Naturelle, Paris.

USNM: National Museum of Natural History, Washington, D.C. (formerly United States National Museum).

C/c: canine.

d: deciduous.

I/i: incisor.

M/m: molar.

P/p: premolar.

Results

Ten species of *Microgale* were collected in the RNI d'Andringitra; they may be distinguished by the characters given in the key (Appendix 19-1). Unless otherwise indicated the data given below are confined to specimens collected at RNI d'Andringitra.

Systematic Section

Microgale cowani Thomas, 1882

HOLOTYPE—BM(NH) 82.3.1.25: adult female body in alcohol, skull extracted. Collected mid-March to mid-February 1880 by the Reverend W. Deans Cowan.

TYPE LOCALITY—Ankafana Forest, eastern Bet-sileo (Ankafana = Ankafina, Fianarantsoa, Fianarantsoa Province, 21°12'S 47°12'E; see MacPhee, 1987; Carleton & Schmidt, 1990).

REFERRED MATERIAL—FMNH 151758, 151759: 43 km S Ambalavao, junction of Sahanivoraky and Sahavatoy rivers, RNI d'Andringitra, 810 m, 22°13'S 47°00'E; FMNH 151653, 151654, 151655, 151767, 151770, 151772, 151776, 151777, 151779, 151782, 151783, 151784, 151786, 151788, 151789, and 151796: 40 km S Ambalavao, along Volotsangana River, RNI d'Andringitra, 1210 m, 22°13'S 46°58'E; FMNH 151652, 151656, 151798, 151810, and 151811: 38 km S Ambalavao, along Volotsangana River, RNI d'Andringitra, 1625 m, 22°11'S 46°58'E. Specimens D, E, and F collected by the Cambridge University Expedition from RNI d'Andringitra, 1400–1800 m.

DESCRIPTION—The following description is based on the holotype and the RNI d'Andringitra specimens. Medium-sized, tail moderately short, shorter or subequal to HB. General appearance of the pelage is dark brown, especially on the rump where lighter speckling is reduced; color dorsally speckled brown, hairs with dark gray bases and a mixture of buff and red-brown tips; ventrally gray with a buff wash, hair bases gray with buff tips; tail bicolored, dark brown dorsally, sharply demarcated from the paler venter, which is reddish buff in most specimens, especially proximally; tail well-clothed with long scale hairs that partially obscure the scales, those on the mid-dorsal basal third of the tail overlying 2.5–3 scales; hind feet brown above, dark gray below. Skull (Fig. 19-1)



FIG. 19-1. Crania from left to right of *Microgale cowani* FMNH 151783 and *M. taiva* FMNH 151643. **Above**, lateral view; **below**, dorsal view left and ventral view right.

medium in size, rostrum elongated, nasals extend posteriorly into the interorbital region; frontals large, relative to the parietals, which are reduced in length in the mid-dorsal region; braincase relatively broad and short, junction of supraoccipital and parietal subrectangular, high on dorsal surface of the braincase, occipital large; pronounced diastemata separate teeth of the upper anterior dentition from the first upper incisor (I1) to the second upper premolar (P3), and diastemata are also present on either side of the lower canine and p2. All elements of the talonid of the third lower molar (m3) are present, including the hypoconid, entoconid ridge, talonid basin, and entoconid. For distinctive features of the morphology of the permanent and deciduous dentition, see Figures 19-2 and 19-3.

MEASUREMENTS—External and cranial measurements are presented in Tables 19-1 and 19-2.

VARIATION—There is no obvious indication of sexual dimorphism in size of adults, although the

sample is too small for this hypothesis to be tested. The ratio of females to males in the sample is 1:1; that of juveniles to adults is 1.8:1. All of the juveniles are classed as Stage 1 (MacPhee, 1987, p. 13) or younger; the anterior dentition is completely deciduous in most specimens but the molars are usually fully erupted, although the third upper molar (M3) is incompletely erupted in two specimens (FMNH 151796 and 151798), whereas the third upper incisor (I3) is the only permanent antemolar tooth erupting or erupted in the (Stage 1) individuals.

Juveniles were compared with adults in four linear dimensions (HB, CIL, UTL, and BB) and WT. The mean of each measurement is slightly smaller in juveniles, with the exception of HB, in which the mean size of juveniles is greater than that of adults (see Table 19-1). These data on body size confirm the observation of Leche (1907) that juveniles may attain adult body size before replacing any deciduous teeth, and that of

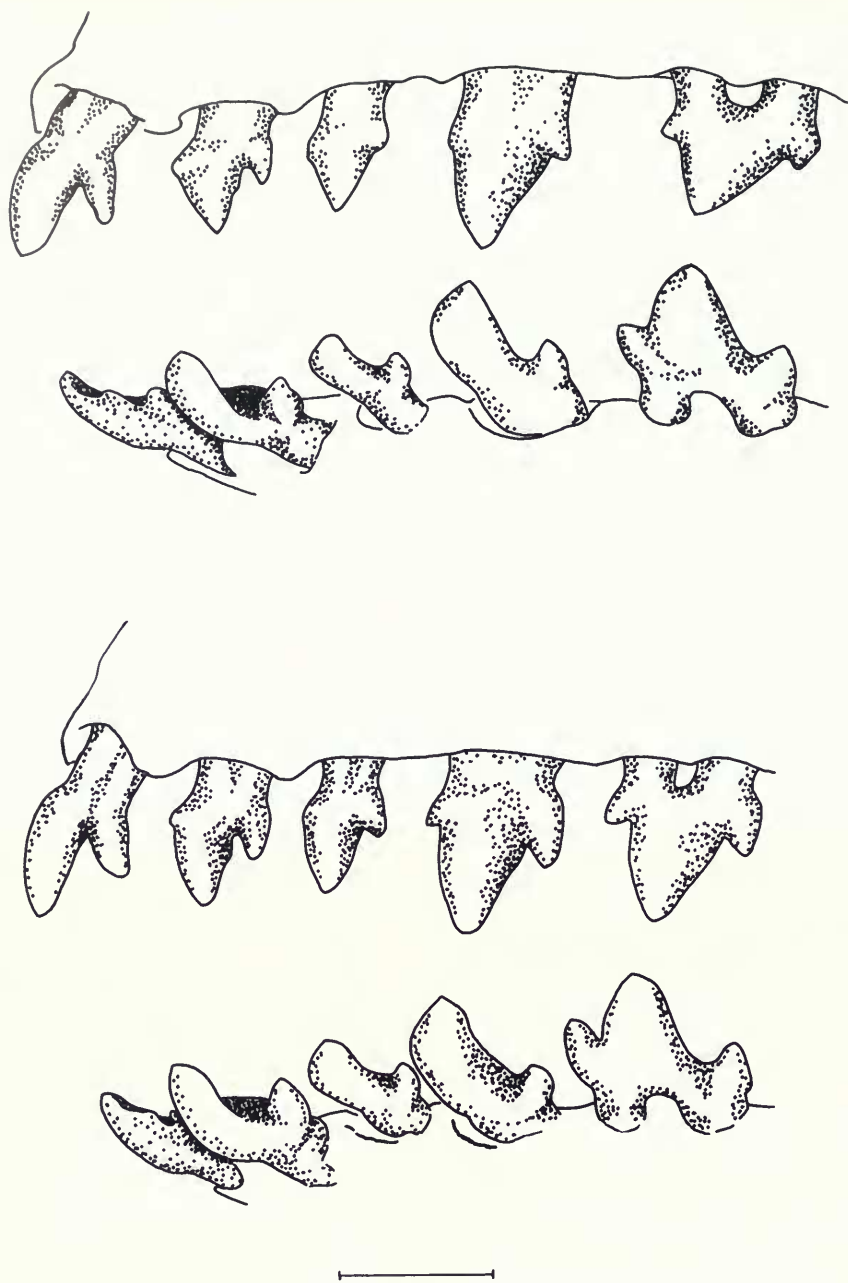


FIG. 19-2. Above, buccal view of permanent left anterior dentition of *M. cowani* FMNH 151783; below, *M. taiva* FMNH 151635 (upper tooththrow) and FMNH 151638 (lower tooththrow). Scale 1 mm.

MacPhee (1987) that subadults may exceed mean adult size in some parameters, including head and body length.

REPRODUCTION—An adult male (FMNH 151652) had abdominal testes measuring 7×5 mm with a convoluted epididymis. Four adult females for

which details on reproductive condition were available had enlarged mammae, perforated vaginas, and in one case two placental scars on the left oviduct and three on the right. Mammary formula: 2-0-4 ($N = 5$). There is little information on the reproductive age of the juvenile specimens;

one female (FMNH 151655) with completely deciduous antemolar dentition was nulliparous, whereas a second female (FMNH 151653) with a deciduous antemolar dentition apart from I3 was perforate but lacked embryos. This limited information suggests that females in this species may become reproductively mature while still dentally immature.

REMARKS—Formerly considered to be the most widespread and commonly occurring species throughout northern, eastern, and southeastern Madagascar, this species is here restricted to the holotype from Ankafina and the specimens listed above from the RNI d'Andringitra. It may be much rarer in collections than previous accounts have indicated. *Microgale cowani* occurs sympatrically with *M. melanorrhachis* and *M. taiva* at RNI d'Andringitra; those taxa were considered to be synonyms of *M. cowani* by MacPhee (1987). Characters used to discriminate this species from others occurring in the RNI d'Andringitra are given in the key (Appendix 19-1) and Table 19-1. Those that separate *M. cowani* and *M. taiva* are given in Table 19-2.

***Microgale taiva* Major, 1896b**

Microgale cowani Thomas: MacPhee, 1987, in part

HOLOTYPE—BM(NH) 97.9.1.112: juvenile female, skin and skull; BM(NH) 1975.2233: partial skeleton. Collected January 19, 1895 by C. I. For-syth Major.

TYPE LOCALITY—Ambohimitombo forest, Tana-la Country (Ambohimitombo town, Fianarantsoa, Fianarantsoa Province, 20°43'S 47°26'E; see MacPhee, 1987).

REFERRED MATERIAL—FMNH 151633, 151634, 151642, 151643, and 151645: 45 km S Ambalavao, E bank of Iantara River, along Ambalaman-jana—Ambatamboay Trail, edge of RNI d'Andringitra, 720 m, 22°13'S 47°01'E; FMNH 151635, 151636, 151637, 151755, 151757, 151760: 43 km S Ambalavao, junction of Sahan-ivoraky and Sahavato rivers, RNI d'Andringitra, 810 m, 22°13'S 47°00'E; FMNH 151638, 151639, 151761, 151762, 151763, 151765, 151769, 151771, 151774, 151775, 151780, and 151781: 40 km S Ambalavao, along Volotsangana River, RNI d'Andringitra, 1210 m, 22°13'S 46°58'E; FMNH 151640, 151641, 151657, 151658, 151724, 151725, 151790, 151791, 151792,

151797, 151802, 151809, and 151813: 38 km S Ambalavao, along Volotsangana River, RNI d'Andringitra, 1625 m, 22°11'S 46°58'E. Cambridge University Expedition specimens B and C, RNI d'Andringitra, 1400–1800 m.

DESCRIPTION—Based on the holotype and specimens collected in the RNI d'Andringitra. Medium-sized, tail moderately long, subequal or longer than head and body length (see Tables 19-1 and 19-2). Dorsal pelage dark brown with buffy brown speckling, ventral coloration gray-brown with buffy brown wash; tail not obviously bicolored, dark gray-brown above, slightly paler gray below; tail scale hairs short, overlying 1.5–2 scales on the dorsal proximal third of the tail, so that the scales are visible. Skull medium in size (see Fig. 19-1), with a moderately elongated rostrum, nasals extend to level of zygomatic plate, barely into interorbital region; frontals posteriorly inflated so that the dorsal surface of the skull appears slightly concave in profile; braincase broad and long, parietals moderately large, supraoccipital–parietal suture suboval. Short diastemata separate the anterior upper dentition from I1 to P3 and are present between the lower canine and p2. Talonid of m3 slightly reduced, entoconid lacking. Distinctive features of the morphology of the permanent and deciduous dentition are shown in Figures 19-2 and 19-3.

MEASUREMENTS—External and cranial measurements are presented in Table 19-1 and 19-2.

VARIATION—Although the mean of HB, WT, and three cranial dimensions in adult female *M. taiva* is consistently higher than that of males, this difference was found to be statistically insignificant, and it is concluded that sexual dimorphism is not present in the small sample available. The sex ratio of females to males in the adult sample is 1:2.3, and the ratio of juveniles to adults is 1:1.2. Two specimens (FMNH 151641 and 151813) are dentally immature—the antemolar teeth are completely deciduous and the third upper and lower molars (M3 and m3) are in the process of eruption; five specimens show deciduous antemolar dentition but fully erupted molars; I3 and/or the third lower incisor (i3) are erupting in three other specimens. In one specimen (FMNH 151636) only i3 has erupted and I3 and the first lower premolar (p2) are beginning to erupt; it is classed as Stage 1–2 (following MacPhee, 1987, p. 13), yet it has fairly large testes (4 × 2) and a convoluted epididymis. Another specimen (FMNH 151642) is difficult to fit into a particular category, because I1, I3, i3, p2, and p4 are all

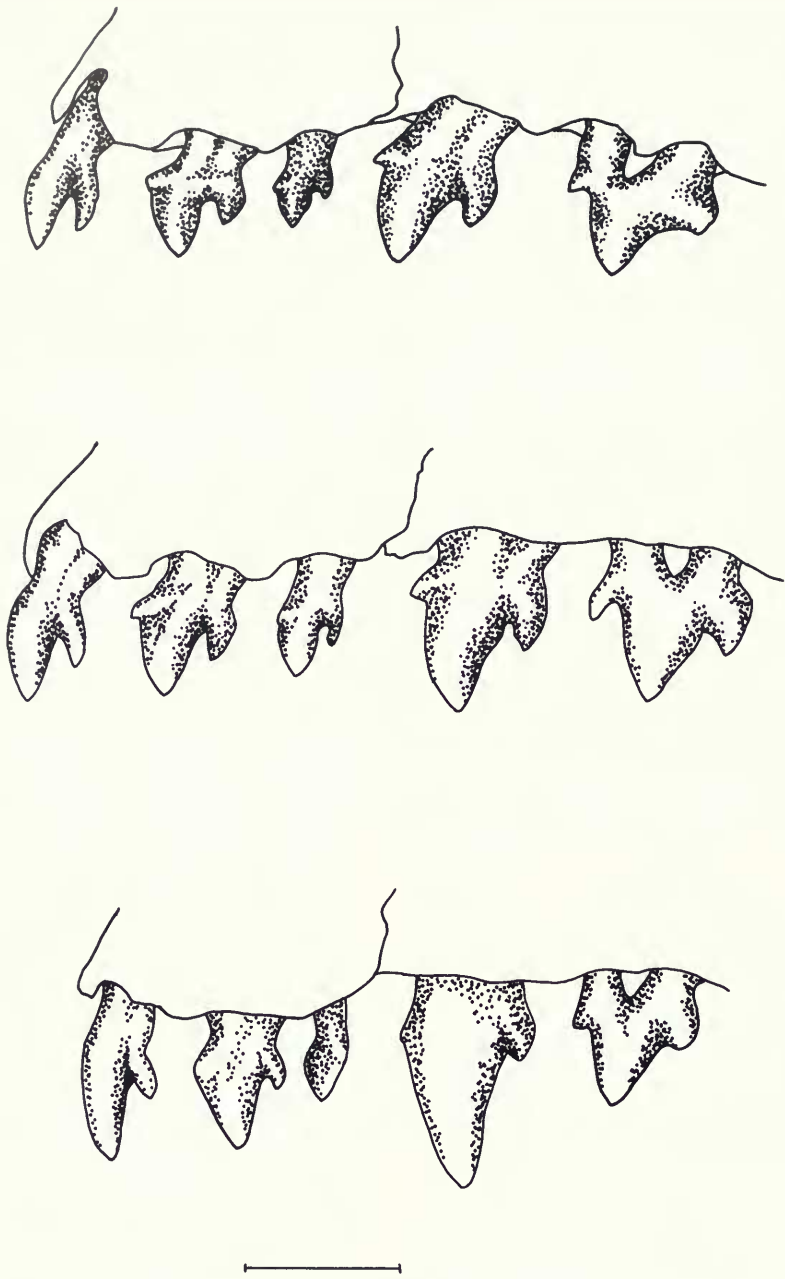


FIG. 19-3. **Top**, buccal view of deciduous left anterior upper dentition of *M. cowani* FMNH 151798; **middle**, *M. taiva* FMNH 151725; **below**, *M. melanorrhachis* FMNH 151626. Scale 1 mm. Figure continues on page 199.

starting to erupt, but in contrast it has small testes (2×1), and the epididymis is not convoluted. In HB, CIL, UTL, and BB, the mean of these juveniles is slightly less than that of the adults, although the mean WT of juveniles is considerably less (9.0 ± 1.8 g, $N = 15$) than that of adults

(12.4 ± 1.2 g, $N = 18$; see Table 19-1). The dentally most mature juvenile and many of the other juveniles are well within the adult range in all of these dimensions, supporting the view that immature *Microgale* achieve large size while deciduous teeth are still present and that the deciduous

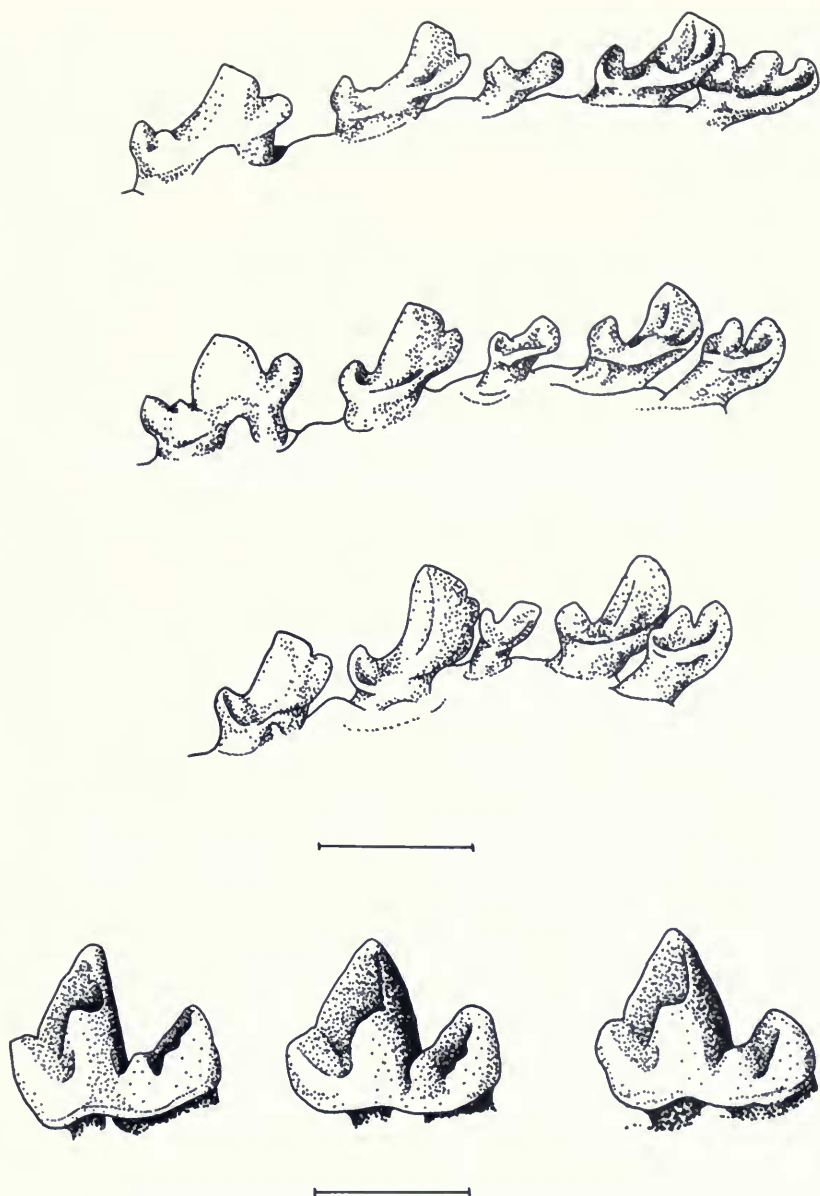


FIG. 19-3 (cont.). **Top:** above, lingual view of deciduous left anterior lower dentition of *M. cowani* FMNH 151776; middle, *M. taiva* FMNH 151725; below, *M. melanorrhachis* FMNH 151626. Scale 1 mm. **Bottom:** Lingual view of right m3 from left to right of *M. cowani* FMNH 151776, *M. taiva* FMNH 151725, and *M. melanorrhachis* FMNH 151626. Scale 1 mm.

dentition may be maintained into adulthood (Leche, 1907; MacPhee, 1987; Jenkins 1992).

REPRODUCTION—Two of the adult females collected were carrying embryos, both with single embryos in the left and right oviducts, measuring 6 and 7 mm crown–rump length. Mammary for-

mula: 0-2-4 (N = 1), 0-2-2 (N = 1), 2-0-4 (N = 2). The testes of three adult males in the sample (FMNH 151633, 151643, and 151547) measure 6 × 3, 7 × 3, and 8 × 4 mm, respectively, all with convoluted epididymides. Information is lacking for females of this species, but it seems likely

TABLE 19-1. Selected external measurements (mm) and weight (g) of *Microgale* spp. collected during the RNI d'Andringitra survey. Descriptive statistics presented as mean \pm standard deviation, minimum-maximum (number of specimens).

Species	Age	TOTL	HB	TL	HF	EL	WT
<i>M. parvula</i>	adult	118.7 \pm 7.0 110-128 (6)	59.3 \pm 3.4 54-64 (6)	60.0 \pm 4.1 55-66 (6)	10.0 \pm 0.6 9-11 (6)	8.7 \pm 0.4 8-9 (6)	3.1 \pm 0.4 2.8-3.9 (6)
	juvenile	114.5 \pm 3.3 112-119 (4)	56.5 \pm 1.9 55-59 (4)	55.8 \pm 1.0 55-57 (4)	9.8 \pm 0.5 9-10 (4)	7.8 \pm 1.3 6-9 (4)	2.9 \pm 0.1 2.8-3.0 (4)
<i>M. longicaudata</i>	adult	187.8 \pm 8.5 182-200 (4)	67.3 \pm 3.8 63-72 (4)	120.8 \pm 6.0 115-129 (4)	14.8 \pm 1.0 14-16 (4)	14.5 \pm 0.6 14-15 (4)	6.3 \pm 0.8 5.6-7.5 (4)
	juvenile	179.0 \pm 7.8 167-188 (6)	61.8 \pm 3.2 59-67 (6)	116.8 \pm 4.2 112-122 (6)	15.0 \pm 0.0 15-15 (6)	13.0 \pm 0.6 12-14 (6)	4.3 \pm 0.5 4.0-5.4 (6)
<i>Microgale</i> sp. A <i>M. cowani</i>	adult	168, 165 147.1 \pm 4.2	81, 79 80.7 \pm 2.8	85, 89 65.0 \pm 3.1	16, 15 16.1 \pm 0.9	16, 17 14.9 \pm 1.1	14.5, 15.0 13.6 \pm 1.4
	adult	143-156 (8) 145.2 \pm 4.7	76-95 (9) 81.5 \pm 4.9	61-71 (8) 65.6 \pm 2.8	15-18 (9) 16.4 \pm 0.6	14-17 (9) 14.0 \pm 0.9	11.0-15.5 (9) 11.3 \pm 2.8
<i>M. taiva</i>	juvenile	140-154 (14) 169.2 \pm 4.9	75-88 (14) 81.9 \pm 3.9	62-72 (14) 88.2 \pm 4.3	16-18 (14) 17.9 \pm 0.8	13-16 (14) 15.9 \pm 0.6	8.2-14.5 (14) 12.4 \pm 1.2
	adult	160-177 (18) 159.6 \pm 6.2	71-89 (18) 74.9 \pm 3.5	80-95 (18) 85.8 \pm 7.4	16-19 (18) 17.1 \pm 1.2	15-17 (18) 14.4 \pm 0.7	10.5-14.5 (18) 9.0 \pm 1.8
<i>M. melanorrhachis</i> <i>M. gymnorhyncha</i>	juvenile	144-167 (15) 147, 142, 138	67-79 (15) 76, 77, 68	62-93 (15) 73, 67, 67	15-19 (15) 18, 15, 15	13-15 (15) 15.5, 14, 14	6-12 (15) 8.6, 9.2, 8.2
	adult	154.5 \pm 1.0 153-155 (4)	94.3 \pm 0.5 94-95 (4)	60.3 \pm 1.0 59-61 (4)	14.8 \pm 0.5 14-15 (4)	14.5 \pm 3.5 11-18 (4)	18.3 \pm 1.9 15.5-19.5 (4)
<i>M. gracilis</i>	juvenile	158 124	92 75	66 46	15 13	11 10	15.5 9.7
	infant	182, 180 185	94, 105 103	84, 75 82	19, 18 19	15, 16 16	25.0, 23.5 19.5
<i>M. soricoides</i> <i>M. dobsoni</i>	adult	200, 185 235, 215	100, 86 109, 108	104, 95 122, 100	18, 18 23, 21	16, 19 21, 18	20.5, 18.0 33.5, 28.5

TABLE 19-1. *Continued.*

Species	Age	CIL	UTL	BB
<i>M. parvula</i>	adult	16.3 \pm 0.19	7.4 \pm 0.13	6.6 \pm 0.22
	juvenile	16.1-16.6 (4)	7.2-7.5 (4)	6.4-6.9 (4)
		16.3 \pm 0.25	7.3 \pm 0.05	6.6 \pm 0.12
<i>M. longicaudata</i>	adult	16.0-16.7 (4)	7.2-7.3 (4)	6.5-6.8 (4)
		19.0 \pm 0.40	8.8 \pm 0.2	8.2 \pm 0.07
	juvenile	18.5-19.4 (4)	8.6-9.0 (4)	8.1-8.3 (4)
<i>Microgale</i> sp. A		18.1 \pm 0.43	8.4 \pm 0.19	8.0 \pm 0.11
	adult	17.3-18.4 (4)	8.1-8.6 (4)	7.8-8.1 (4)
		21.0 \pm 0.24	10.3 \pm 0.25	9.6 \pm 0.09
<i>M. cowani</i>	adult	20.7-21.2 (3)	10.0-10.6 (3)	9.5-9.7 (3)
		22.4 \pm 0.45	10.7 \pm 0.19	10.1 \pm 0.18
	juvenile	21.4-23.0 (11)	10.4-11.0 (11)	9.8-10.3 (11)
<i>M. taiva</i>		22.0 \pm 0.53	10.6 \pm 0.37	9.9 \pm 0.11
	adult	21.1-22.5 (8)	10.1-11.2 (8)	9.8-10.1 (8)
		22.8 \pm 0.39	10.8 \pm 0.28	9.9 \pm 0.21
<i>M. melanorrhachis</i>	juvenile	22.1-23.5 (17)	10.3-11.3 (17)	9.6-10.3 (17)
		22.1 \pm 0.55	10.6 \pm 0.23	9.7 \pm 0.17
	juvenile	21.3-23.1 (9)	10.2-10.8 (9)	9.4-10.0 (9)
<i>M. gymmorhyncha</i>		21.3 \pm 0.22	10.3 \pm 0.22	
	adult	21.2, 22.5 (2)	10.0-10.5 (3)	8.9, 9.1 (2)
		26.0 \pm 0.39	13.8 \pm 0.24	10.2 \pm 0.14
<i>M. gracilis</i>	juvenile	25.6-26.5 (3)	13.5-14.1 (4)	10.1-10.4 (3)
	adult	25.3, 25.4 (2)	13.3, 13.4 (2)	10.1, 10.4 (2)
		28.8 \pm 0.72	14.4 \pm 0.38	10.8 \pm 0.12
<i>M. soricoides</i>	juvenile	27.9-29.6 (4)	14.0-14.9 (4)	10.4-10.9 (4)
	adult	28.1 (1)	14.0 (1)	10.9 (1)
	adult	24.6 (1)	12.2, 12.3 (2)	11.3 (1)
<i>M. dobsoni</i>	adult	30.0, 31.8 (2)	15.0, 15.7 (2)	11.2, 11.7 (2)

Refer to Materials and Methods, Specimens, and Measurements sections for clarification of abbreviations.

TABLE 19-2. Dimensions (in mm) distinguishing *Microgale cowani* from *M. taiva* in the RNI d'Andringitra.

Parameter	<i>M. cowani</i>	<i>M. taiva</i>
Tail length	60.6–71.0 65.6 ± 3.25 (10)	71.0–89.0 88.4 ± 4.60 (14)
Ratio of tail length to condyloincisive length	2.7–3.1 3.0 ± 0.13 (10)	3.5–4.2 3.9 ± 0.19 (14)
Length of anterior denti- tion I–P3	5.5–6.2 5.8 ± 0.2 (11)	5.2–5.8 5.5 ± 0.21 (14)
Ratio of anterior denti- tion (I–P3) to upper toothrow length	52.8–56.4 53.9 ± 1.08 (11)	49.1–52.8 50.7 ± 0.88 (14)
Braincase length	7.3–8.2 7.8 ± 0.24 (11)	7.8–8.4 8.1 ± 0.17 (14)

from the well-developed testes in the dentally immature (Stage 1–2) male (FMNH 151636) that males may become sexually mature before they acquire their complete permanent dentition.

REMARKS—The holotype of this species is a juvenile. It was considered a synonym of *Microgale cowani* by MacPhee (1987) on the basis of its dentition. Recently collected adults confirm that although the permanent dentition is indeed similar, it does differ slightly from that of *M. cowani* in that the talonid of m3 is slightly reduced and the entoconid is lacking. The deciduous antemolar dentition also differs from that of *M. cowani* (and *M. melanorrhachis*). The two taxa do occur sympatrically in the RNI d'Andringitra, where they are readily distinguished from each other by differences in their external appearance, including those of absolute and relative tail length, tail coloration and pilosity, by a combination of cranial characters, and by minor differences in the dentition (see Tables 19-1 and 19-2, and Figs. 19-1, 19-2, and 19-3).

Microgale melanorrhachis Morrison-Scott, 1948

Microgale cowani Thomas: MacPhee, 1987, in part

HOLOTYPE—BM(NH) 48.88: juvenile female, skin and skull, collected November 22, 1939 by C. S. Webb.

TYPE LOCALITY—Périnet (= Andasibe), near Moramanga, eastern Madagascar, 19°00'S

48°30'E, altitude 3000 feet (= approximately 900 m).

REFERRED MATERIAL—FMNH 151626: 45 km S Ambalavao, E bank of Iantara River, along Ambalamanenjana—Ambatamboay Trail, edge of RNI d'Andringitra, 720 m, 22°13'S 47°01'E; FMNH 151627 and 151756: 43 km S Ambalavao, junction of Sahanivoraky and Sahavatoy rivers, RNI d'Andringitra, 810 m, 22°13'S 47°00'E.

DESCRIPTION—This description is based solely on juvenile specimens from RNI d'Andringitra. Similar in size to *M. cowani* and *M. taiva* juveniles of equivalent dental age (HB 68–77, mean 73.7 ± 4.03, N = 3); tail length (67–73, mean 69.0 ± 2.83, N = 3) similar to that of *M. cowani* but much shorter than that of *M. taiva* (see Table 19-1). Dorsal pelage gray-brown with some yellowish speckling and with a distinct dark brown mid-dorsal stripe extending from the head at the level of the ears to the base of the tail. Dorsal hairs with light gray bases, buffy red terminally with short dark brown tips; venter gray with a buff wash, hairs with light gray bases and long white tips. Tail bicolored, dark gray dorsally, buff ventrally; sparse covering of scale hairs, each overlapping 1.5–2 scales in the dorsal basal third of the tail. Hind feet buff above, dark gray-brown laterally and below. Skull similar in size to those of juvenile *M. cowani* and *M. taiva* (CIL 21.2, 22.5 mm); rostrum moderately elongated and with short diastemata between the anterior upper teeth, as in *M. taiva* but unlike the longer diastemata of *M. cowani*; braincase narrower and shallower than that of *M. cowani* and *M. taiva*, shorter than that of *M. taiva*. The deciduous antemolar dentition differs from those of *M. cowani* and *M. taiva* (see Fig. 19-3a,b). The talonid of m3 is slightly reduced, the talonid basin is narrow, and the entoconid is lacking (see Fig. 19-3c).

MEASUREMENTS—External and cranial measurements are presented in Table 19-1.

VARIATION—The pelage of the RNI d'Andringitra specimens differs in coloration from that of the holotype, which is more rufous brown dorsally, and the dorsal surface of the hind feet and ventral surface of the tail are more reddish buff in color than that of the holotype.

REPRODUCTION—All of the specimens obtained were juveniles, with deciduous antemolar dentitions and with fully erupted molars. In one of the two males for which reproductive condition was recorded (FMNH 151626), the immature testes measured 2 × 2 mm and the epididymis was not convoluted. The single female (FMNH 151627)

in which i3 was beginning to erupt had a possible perforated vagina but showed no other signs of sexual maturity.

REMARKS—MacPhee (1987) considered *M. melanorrhachis* to be a synonym of *M. cowani* on the basis of its dentition, arguing that the mid-dorsal stripe used to characterize the taxon is variably present or absent in *M. cowani*. Although Grandidier (1934) suggested that striping is a juvenile characteristic, MacPhee (1987) pointed out that loss or diminution of the stripe, perhaps following molting, was not in phase with replacement of the deciduous dentition and also occurred in dental adults. The contention that *M. melanorrhachis* is a synonym of *M. cowani* has never gained wide acceptance. Nicoll and Rathbun (1990) states that adults of *M. cowani* and *M. melanorrhachis* occur with overlapping ranges at Andasibe, whereas Raxworthy and Nussbaum (1994) and Stephenson (1995) also treat *M. melanorrhachis* as a distinct species. All of the specimens from the RNI d'Andringitra are juveniles and are clearly distinguishable from juveniles of *M. cowani* and *M. taiva* by craniodental features in addition to the distinctive pelage.

***Microgale longicaudata* Thomas, 1882**

***Microgale majori* Thomas, 1918**

HOLOTYPE—BM(NH) 82.3.1.15: adult female, body in alcohol, skull extracted, collected mid-March to mid-February 1880 by the Reverend W. Deans Cowan.

TYPE LOCALITY—Ankafana Forest, eastern Bet-sileo (Ankafana = Ankafina, Fianarantsoa, Fianarantsoa Province, 21°12'S 47°12'E; see MacPhee, 1987; Carleton & Schmidt, 1990).

REFERRED MATERIAL—FMNH 151628, 151630, and 151631: 45 km S Ambalavao, E bank of Iantara River, along Ambalamanenjana–Ambatamboay Trail, edge of RNI d'Andringitra, 720 m, 22°13'S 47°01'E; FMNH 151632, 151795, 151799, 151800, 151803, and 151804: 38 km S Ambalavao, along Volotsangana River, RNI d'Andringitra, 1625 m, 22°11'S 46°58'E; Cambridge University Expedition specimen A: RNI d'Andringitra, 1400–1800 m.

DESCRIPTION—Body small in size, with a very long tail, considerably longer than that of the head and body. Dorsal pelage dark brown with a reddish brown wash, ventrally dark gray with a reddish buff wash; tail gray-brown above, sharply

distinguished from the reddish buff ventral coloration; hind feet brown but reddish buff laterally. Skull small, dorsal profile slightly concave (Fig. 19-4), rostrum moderately short, nasals extend posteriorly into the interorbital region; braincase long, parietals and occipital large, suboval supraoccipital suture on dorsal surface of the braincase. Diastemata are present between I1 and I2 and on both sides of C and P2; well-developed anterior and posterior accessory cusps are present on I2, C, and P2. Lower p2 caniniform. Talonid of m3 with well-developed hypoconid and hypoconulid, arrow talonid basin, and reduced entoconid ridge and entoconid.

MEASUREMENTS—External and cranial measurements are presented in Table 19-1.

VARIATION—In the sex ratio of the small sample available, males outnumber females (2.5:1); the juvenile to adult ratio is 1.5:1. The juveniles collected in the RNI d'Andringitra exhibit a completely deciduous antemolar dentition and in most M3 is incompletely erupted. There are only slight differences between the morphology of the deciduous incisors and first premolar (dp2) and that of the permanent teeth.

REPRODUCTION—Only two of the specimens showed signs of reproductive activity—a male (FMNH 151799) with testes measuring 5 × 3 mm and a convoluted epididymis; and a lactating female (FMNH 151630), collected on November 20, 1993, with single placental scars on the left and right oviducts. Mammary formula: 0-2-2 (N = 1), 2-0-4 (N = 1).

REMARKS—*Microgale longicaudata* has been reported in eastern Madagascar from Antsiranana in the extreme north (12°16'S 49°18'E) to Ankafina (21°12'S 47°13'E) (MacPhee, 1987; Jenkins, 1993). The presence of this species in the RNI d'Andringitra marks a southern extension of the recorded range. Thomas (1882) described a long-tailed species (*M. longicaudata*) from a series of specimens from Ankafina, smaller specimens of which he later transferred to a new species, *M. majori* Thomas, 1918. MacPhee (1987) considered the two taxa synonymous. The specimens from the RNI d'Andringitra fall in the lower part of the size range given by MacPhee (1987) for *M. longicaudata*. This species shows several morphological features that suggest it is adapted to an arboreal lifestyle (see Thomas, 1918). These features include the extremely long tail, the bare region near the tip with transverse scales, the elongated fifth digit on the hind foot, and the elongated cheiridia. The elongated tail distinguishes



FIG. 19-4. Crania from left to right of *M. longicaudata* FMNH 151799 and *M. parvula* FMNH 151623. Above, lateral view; below, dorsal view left and ventral view right.

this species from all others occurring in the RNI d'Andringitra. Other distinguishing features are given in the key (Appendix 19-1) and Table 19-1.

Microgale parvula Grandidier, 1934

?*Microgale pulla* Jenkins, 1988

HOLOTYPE—MCZ 45465: juvenile male, body in alcohol, skull extracted. Collected by M. Drouhard.

TYPE LOCALITY—Environs of Diego Suarez (Antsiranana, ca. 12°16'S 49°18'E—see MacPhee, 1987).

REFERRED MATERIAL—FMNH 151621: 45 km S Ambalavao, E bank of Iantara River, along Amalamanenjana-Ambatamboay Trail, edge of RNI d'Andringitra, 720 m, 22°13'S 47°01'E; FMNH 151622: 43 km S Ambalavao, junction of Sahan-

ivoraky and Sahavatoy rivers, RNI d'Andringitra, 810 m, 22°13'S 47°00'E; FMNH 151722, 151764, and 151766: 40 km S Ambalavao, along Volotsangana River, RNI d'Andringitra, 1210 m, 22°13'S 46°58'E; FMNH 151623, 151723, 151793, 151794, 151801, 151805, and 151806: 38 km S Ambalavao, along Volotsangana River, RNI d'Andringitra, 1625 m, 22°11'S 46°58'E.

DESCRIPTION—Very small, tail subequal in length to that of head and body. Dorsal pelage dark gray-brown, ventral pelage dark gray, tail uniform dark gray. Skull very small, delicate, and elongated in appearance (see Fig. 19-4), rostrum slender, moderately short; braincase shallow and long, frontals and occipital large relative to parietals, occipital condyles posterodorsally orientated. Diastemata present between I1 and I2 and on either side of C and P2; anterior and posterior accessory cusps present on I2, I3, and P2. Diastema between c and p2. Talonid of m3 with well-

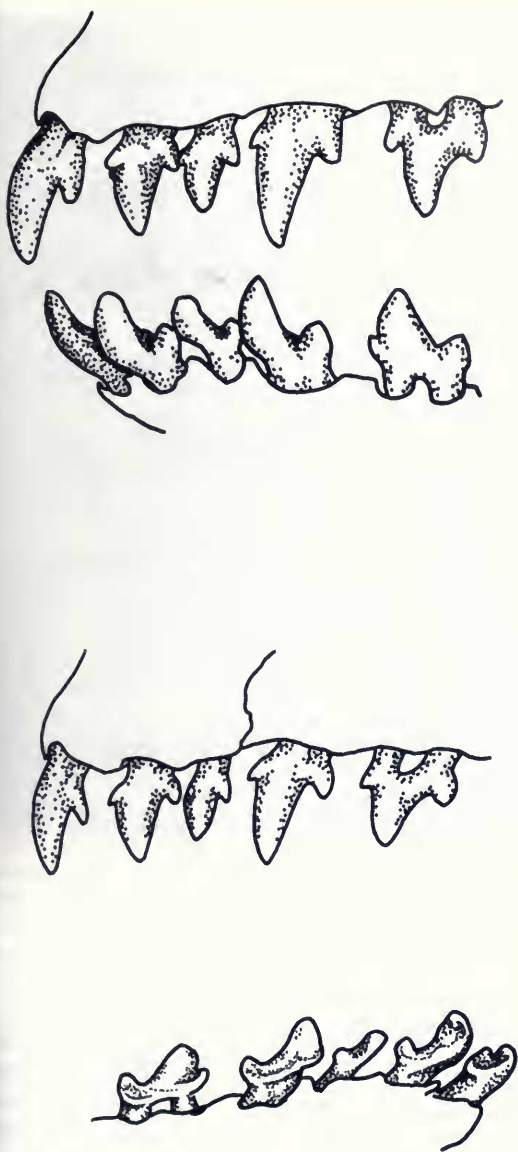


FIG. 19-5. Left anterior dentition of *M. parvula*. **Above**, buccal view of permanent dentition of FMNH 151623; **middle**, buccal view of deciduous upper dentition of FMNH 151806; **below**, lingual view of deciduous lower dentition of FMNH 151622. Scale 1 mm.

developed hypoconulid but reduced hypoconid, entoconid, and entoconid ridge, and narrow, shallow talonid basin. See Figure 19-5 for illustrations of the permanent and deciduous dentition.

MEASUREMENTS—External and cranial measurements are presented in Table 19-1.

VARIATION—The sex ratio of males to females in the small sample is 1.3:1, and that of juveniles

to adults is 1.5:1. The antemolar dentition is deciduous, and all molars are fully erupted in all four juveniles.

REPRODUCTION—Few of the specimens collected showed active reproductive organs. At least two of the males that were adult based on dentition had small testes without convoluted epididymides; the testes of FMNH 151623 measured 2×1 mm, and those of FMNH 151723 measured 3×2 mm. One adult female (FMNH 151621) obtained on November 15, 1993, had two embryos in each oviduct measuring 4 mm crown-rump length. Mammary formula: 0-0-4 ($N = 1$), 0-2-4 ($N = 1$). Information is lacking on the reproductive condition of juvenile males with deciduous dentition, but a female (FMNH 151766) with deciduous antemolar dentition was perforate.

REMARKS—The specimens collected in the RNI d'Andringitra include both adults and juveniles that are clearly attributable to the same species. *Microgale parvula* is known only from the original description of the single juvenile specimen, the dentition of which was illustrated by MacPhee (1987), who also corrected the measurements given in the original description. The dentition of the juveniles from RNI d'Andringitra agrees well with the illustrations of the dentition of *M. parvula* in MacPhee (1987), and the corrected upper toothrow length given by MacPhee is similar. There are, however, some differences in size; the corrected skull length of the holotype (15.5 mm) is less than that in the three juvenile specimens from RNI d'Andringitra with deciduous antemolar dentitions (i.e., of equivalent dental age), in which CIL is 16.2–16.7 mm. The tail of the holotype is longer than its head and body length (TL:HB 1.21), whereas the tail is subequal to or slightly larger than head and body length in these specimens (TL:HB 0.96–1.07). Comparisons have also been made between the adult specimens from RNI d'Andringitra and the adult holotype specimen of *M. pulla* Jenkins, 1988. They agree in most features of size, external characters, and craniodental morphology, except for the TL to HB ratio, which is greater than that in the holotype of *M. pulla* (0.83). When *M. pulla* was described (Jenkins, 1988), the possibility was mentioned that it might simply represent the adult of *M. parvula*, and the conclusion from the study of these specimens from RNI d'Andringitra is that this is probably correct, although direct comparison of specimens is required for confirmation.

***Microgale dobsoni* Thomas, 1884**

Nesogale dobsoni Thomas, 1918

HOLOTYPE—BM(NH) 84.10.20.1: immature male, in alcohol, skull extracted. Collected February or March 1884 by W. Waters.

TYPE LOCALITY—Nandésen forest, Central Betileo (Nandihizana, 10 miles S Ambositra—manuscript note in Thomas's private copy of original description. Nandihizana, ca. 20 miles [30 km] SSW Ambositra, see MacPhee, 1987. Estimated as 20°50'S 47°10'E).

REFERRED MATERIAL—FMNH 151624, 151625, and 151785: 40 km S Ambalavao, along Volotsangana River, RNI d'Andringitra, 1210 m, 22°13'S 46°58'E.

DESCRIPTION—Head and body large, tail subequal to or longer than head and body. Pelage long, dorsally gray-brown with a buff or reddish buff wash, venter gray with a buff or reddish buff wash. Tail gray above, buff below; hind feet buff. Skull and mandible very large and robust, sutures fused and obscure; rostrum broad, interorbital region long, slightly concave; braincase angular, superior articular facets very prominent, occipital region reduced, supraoccipital crests well developed. Diastemata between I1 and I2 and between I3 and C. Lower i2 considerably larger than canine. The teeth of both individuals are too worn for detailed observations.

MEASUREMENTS—External and cranial measurements are presented in Table 19-1.

VARIATION—The two adults collected in 1993 differ in external appearance; one specimen, with TL 93% of HB, is more rufous in coloration than the other, in which the tail is relatively much longer (TL 112% of HB). A specimen in the MNHN collected from Anjavidilava is slightly lighter in coloration than either of the FMNH specimens, with TL 96% of HB. All three specimens are within the range of color variation exhibited by other specimens of this taxon in the BM(NH) collection. The range of TL:HB is 82–111% (mean $94.1 \pm 7.67\%$, $N = 11$) for *M. dobsoni* in the BM(NH) collection, so even the long-tailed specimen (FMNH 151624) is only just outside the known range on this feature. There is no indication in the RNI d'Andringitra specimens of the incrustation of the tail found commonly in this species.

REPRODUCTION—The two female specimens taken in 1993 were adults, on the basis of dentition, and both were lactating. One individual (FMNH 151624) had two placental scars on both



FIG. 19-6. **Above**, right lateral view of the rhinarium of *M. gymnorhyncha* FMNH 151808; **below**, *M. gracilis* FMNH 151773. Scale 1 mm.

the right and left oviducts. Mammary formula: 2-0-4 ($N = 1$). One infant (FMNH 151785), with unopened eyes, was found at night along a trail.

REMARKS—The few specimens collected suggest that this species is uncommon in the area or that population numbers were low at the time of the trapping program. Four specimens of *M. dobsoni* in the MNHN were collected during the 1970–1971 expedition to the Andringitra Massif, in the vicinity of Anjavidilava, and at approximately 1995 m. Two of the specimen labels bear the note “forêt mousse.” Thus, the elevation range of this species within the reserve is presumed to be between about 1200 and 2000 m.

***Microgale soricoides* Jenkins, 1993**

HOLOTYPE—BM(NH) 91.565: adult male in alcohol, skull extracted. Collected April 13, 1991, by C.J.R.

TYPE LOCALITY—Mantady National Park, ca. 15 km north of Périnet (Andasibe), 18°51'S 48°27'E, in primary rain forest, altitude 1100–1150 m.

REFERRED MATERIAL—FMNH 151768 and 151778: 40 km S Ambalavao, along Volotsangana River, RNI d'Andringitra, 1210 m, 22°13'S 46°58'E.

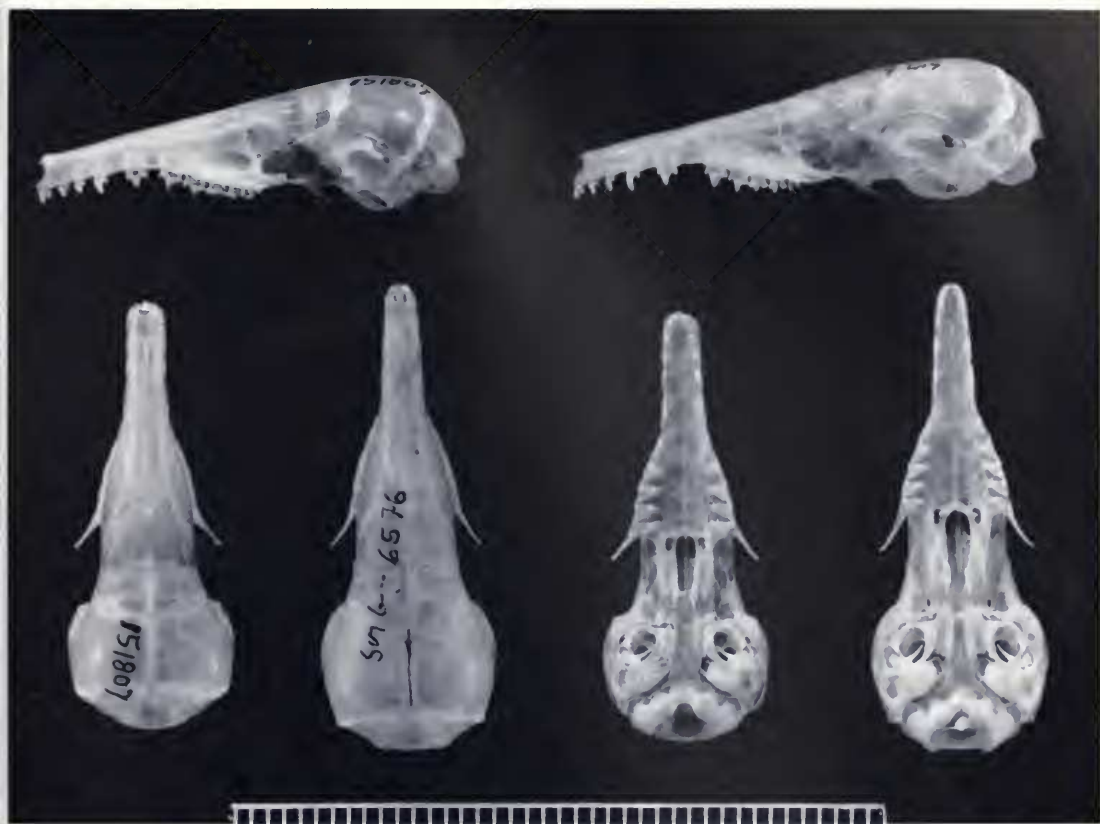


FIG. 19-7. Crania from left to right of *M. gymnorhyncha* FMNH 151807 and *M. gracilis* FMNH 151773. Above, lateral view; below, dorsal view left and ventral view right.

DESCRIPTION—Size large, tail subequal to or longer than head and body. Pelage light gray-brown dorsally, gray-brown ventrally with a buff wash. Tail brown above, paler buffy brown below. Skull and mandible moderately large and robust, rostrum and interorbital region broad, braincase short and broad; parietals large, occipital small, supraoccipital ridge present. First upper I1 markedly robust and proodont. First lower i1 and i2 robust and procumbent, i2 smaller than i1 but larger than c. The first upper and lower premolars are very small and have a single root. The teeth are too worn for determination of the features of m3.

MEASUREMENTS—External and cranial measurements are presented in Table 19-1.

REPRODUCTION—One of the specimens (FMNH 151768) taken on December 1, 1993 was an adult female, based on dentition, and was lactating. Mammary formula: 2-0-4 (N = 1).

VARIATION—The two specimens from RNI d'Andringitra are slightly greater in body size than those from Mantady but fall within the cranial size range (dimensions of the type series, with the RNI d'Andringitra specimens in square brackets: HB 77.0–85.5 mm [86, 100 mm], ratio of TL to HB 0.95–1.13 [1.04, 1.11], CIL 25.1–26.7 mm [24.6 mm], UTL 12.1–13.0 mm [ca. 12.2, 12.3 mm]).

REMARKS—This is the second locality record for the species. Whereas the type series was collected in primary rain forest at an altitude between 1100 and 1150 m, the RNI d'Andringitra specimens were collected at a slightly higher elevation of 1210 m. One of the RNI d'Andringitra specimens was collected 2 m above the ground on a tree limb 3 cm in diameter that led from the ground to a tangle of vines, so this species is obviously capable of climbing in low vegetation.

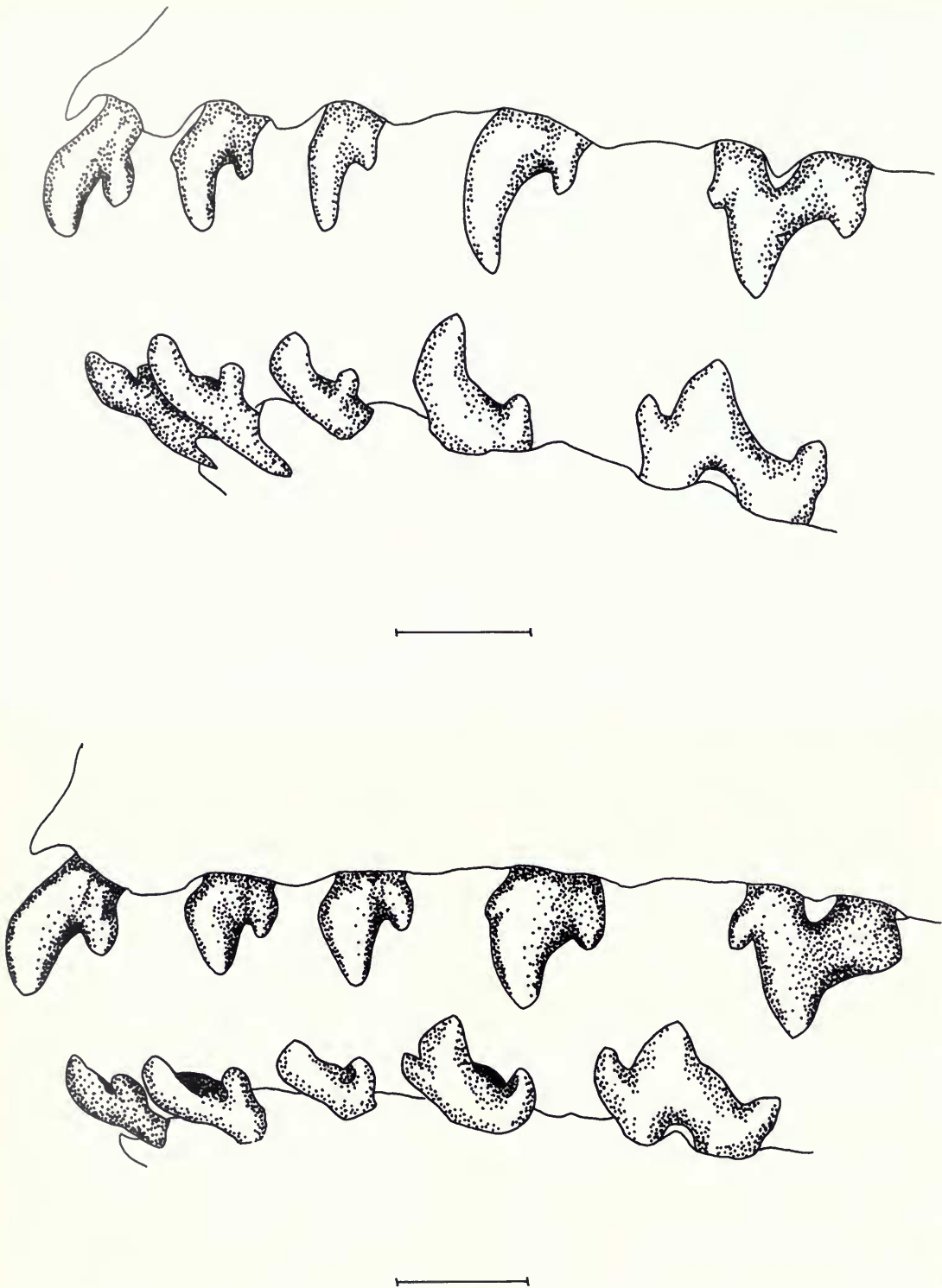


FIG. 19-8. **Top**, buccal view of permanent left anterior dentition of *M. gracilis* FMNH 151773. Scale 1 mm. **Bottom**, buccal view of permanent left anterior dentition of *M. gymnorhyncha* BM(NH) record number 1995.R258. Scale 1 mm. Figure continues on page 209.

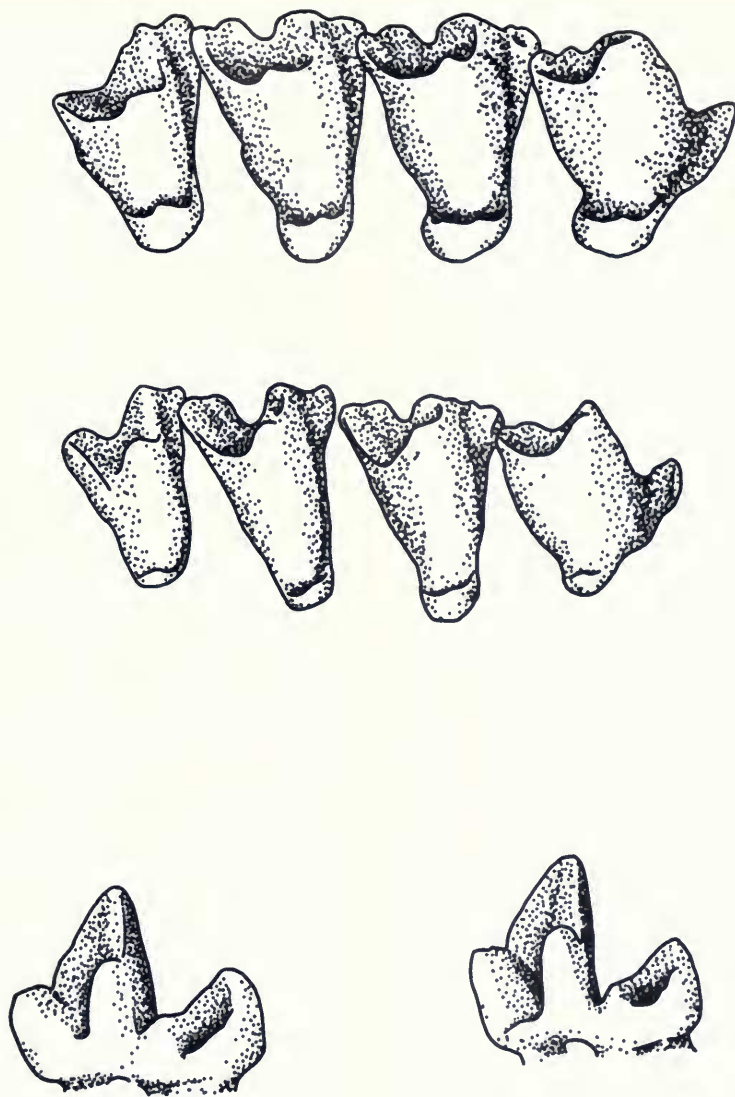


FIG. 19-8 (cont.). **Above**, lingual view of left P4–M3 of *M. gymnorhyncha* BM(NH) record no. 1995.R258; **middle**, *M. gracilis* FMNH 151773; **below**, lingual view from left to right of right m3 of *M. gymnorhyncha* FMNH 151651 and *M. gracilis* FMNH 151649. Scale 1 mm.

***Microgale gracilis* (Major, 1896a)**

Oryzoryctes [sic] *gracilis* Major, 1896a

Leptogale gracilis Thomas, 1918

HOLOTYPE—BM(NH) 97.9.1.78: adult of undetermined sex; skin and skull. Collected November 1894 by C. I. Forsyth Major.

TYPE LOCALITY—Ambohimitombo forest (Am-

bohimitombo town, 43 km [by road] SE Ambo-sitra, 10 km into eastern forest; Fianarantsoa; 20°43'S 47°26'E—see MacPhee [1987]). MacPhee gives the altitude for this locality variously as 1300 m [1987, p. 6] and 1200 m [1987, table 5] but, as pointed out by Carleton & Schmidt [1990], the altitude recorded for this locality by Major [1897] is 1400–1500 m.).

REFERRED MATERIAL—FMNH 151648, 151649, and 151773: 40 km S Ambalavao, along Volotsangana River, RNI d'Andringitra, 1210 m, 22°13'S 46°58'E; MNHN 1972-606, 1972-607: Forêt Agauria (Marositry), Andringitra (2000 m).

DESCRIPTION—Size large, tail shorter than head and body. Pelage dark brown dorsally with buff speckling, ventrally dark gray with a buff wash, tail dark brown above, light brown below; the juveniles are less speckled on the rump than the adults. Muzzle very long; rhinarium large, naked region extends posterodorsally for 4–5 mm, anterior portion reticulated, striae on the posterior region incomplete (Fig. 19-6). Eyes very small; ears small, partially concealed by the pelage, just reaching the posterior corner of the eye if pressed forward. Forefeet broad with enlarged claws, noticeably longer than those of the hind feet. Skull very elongated and gracile (Fig. 19-7), with a slender, elongated, markedly attenuated rostrum; the premaxillae meet the nasals above P2; the nasals extend posteriorly into the elongated interorbital region. The braincase is rounded, moderately broad and long; the parietals are small relative to the long frontals; the occipital is relatively shallow. The pterygoid foramina are partially or completely bridged by the palatine lip, which forms an incomplete or complete transverse bar. The mandible is elongated, tapers anteriorly, and the mental foramen lies below p2 or anterior to p3. The dentition is reduced (Fig. 19-8a,b); upper incisors subequal in height, incisors and canine very slender; extensive diastemata between all of the anterior teeth from I1 to P3, diastema particularly long between P2 and P3; lingual cingulum sometimes present on P2, posterolingual accessory cusp absent; talon on P4 narrow; talons on molars very reduced, resembling cingula. The lower canine lacks an accessory cusp; the talonid of m3 is slightly reduced and the entoconid is lacking.

MEASUREMENTS—External and cranial measurements are presented in Tables 19-1 and 19-3.

VARIATION—The small sample includes an adult male and female and a juvenile male. The dentition of the juvenile (Fig. 19-9) is at Stage 1 of MacPhee (1987, p. 13), at which most of the antemolar teeth are deciduous, except for I3 and i3, whereas I1 has just started to erupt, and the upper and lower molars are fully erupted, as usual in the genus. Features of the deciduous dentition that are common to *Microgale* (small size of the anterior teeth and the resemblance of the

TABLE 19-3. Table of comparative measurements (in mm) of *Microgale gracilis* and *M. gymnorhyncha* from the RNI d'Andringitra. Measurements of the holotype of *M. gracilis* are included in square brackets.

Parameter	<i>M. gymnorhyncha</i>	<i>M. gracilis</i>
Head and body length	83–95 91.5 ± 4.92 (4)	91–105 [ca. 93] 96.3 ± 5.26 (4)
Tail length	59–63.3 60.8 ± 1.48 (4)	75–84 [81] 79.3 ± 3.19 (4)
Ratio of tail length to condyloincisive length	2.3–2.4 2.3 ± 0.05 (3)	2.7–3.0 [2.8] 2.8 ± 0.13 (4)
Condyloincisive length	25.6–26.5 26.0 ± 0.39 (3)	27.9–29.6 [29.0] 28.8 ± 0.72 (4)
Upper tooththrow length	13.5–14.1 13.8 ± 0.24 (4)	14.0–14.9 [14.4] 14.4 ± 0.38 (4)
Length of anterior dentition I–P3	7.0–7.6 7.4 ± 0.23 (4)	8.1–9.0 [8.4] 8.5 ± 0.34 (4)
Ratio of anterior dentition to upper tooththrow length	51.9–54.7 53.6 ± 1.11 (4)	57.8–60.4 [58.3] 58.8 ± 1.05 (4)
Rostral breadth at level of P2	2.8–3.0 2.9 ± 0.08 (4)	2.4–2.7 [2.5] 2.6 ± 0.11 (4)
Braincase length	7.4–7.9 7.6 ± 0.22 (3)	8.4–8.8 [9.0] 8.7 ± 0.15 (4)

buccal cusps on the deciduous third upper premolar [dP4] to those of M1 and M2) also occur in this specimen. This juvenile is, however, unusual in the presence of an additional cuspid between the principal and posterior cusp on the first lower deciduous premolar (dp2) and between the metaconid and the posterior cusp on the third lower deciduous premolar (dp3); these cuspids are lacking in adult *M. gracilis* and have not been observed in other juvenile *Microgale*. The RNI d'Andringitra specimens closely resemble the holotype. In the small sample from the reserve, the pelage of the Marositry specimens is marginally longer than that of those the Volotsangana River.

REPRODUCTION—An adult male (FMNH 151648), based on dentition, had abdominal testes measuring 7 × 3 mm, with a convoluted epididymis. There are no data on the reproductive condition of the other two individuals.

REMARKS—This species is considered to be rare in museum collections (MacPhee, 1987) and is confirmed only from the holotype and the speci-

mens recorded above. Unconfirmed records include a specimen from Ankeramadinika (see Major, 1896a) and an illustration in Leche (1907) of the "milk" dentition of a specimen that is probably correctly attributed to this species. The three specimens from the 1993 mission to RNI d'Andringitra are therefore important to increase knowledge of the taxon. The two MNHN specimens (MNHN 1972-606 and 1972-607) are from the 1970-1971 Andringitra expedition and were taken in "forêt *Agauria*." Based on the date of collection, this would have been at their camp 4 (Marositry), at about 2000 m (Paulian et al., 1971). Thus, the elevational range of this species on the Andringitra Massif appears to be between about 1200 and 2000 m.

Microgale gymnorhyncha, new species

Microgale gracilis (Major): MacPhee, 1987, in part

HOLOTYPE—FMNH 151807: adult female in alcohol, skull extracted (field number SMG 6697). Collected December 13, 1993, by S.M.G. and C.J.R.

TYPE LOCALITY—38 km S Ambalavao, RNI d'Andringitra, on ridge E of Volotsangana River, Fianarantsoa Province, 22°11'39"S 46°58'16"E, altitude 1625 m.

PARATYPES—FMNH 151808: old adult female, intact body in alcohol, (field number SMG 6698) collected December 13, 1993; FMNH 151726: adult female, skull, and complete skeleton (field number SMG 6712), collected December 14, 1993; FMNH 151812: infant, in alcohol, skull extracted (field number SMG 6724) collected December 15, 1993, all with the same collection data as the holotype. FMNH 151650: juvenile male, skin and skull (field number SMG 6579) collected December 1, 1993; FMNH 151651: juvenile male, skin and skull (field number SMG 6614) December 4, 1993, both collected by S.M.G. and C.J.R., 40 km S Ambalavao, RNI d'Andringitra, along Volotsangana River, Fianarantsoa Province, 22°13'22"S 46°48'18"E, altitude 1210 m. BM(NH) record number 1995. R258: adult, in alcohol, skull extracted, collected 1993 from unspecified locality in the RNI d'Andringitra, Fianarantsoa Province.

REFERRED MATERIAL—MNHN 1961-204: 5 km from Fanovana (18°55'S 48°34'E, altitude ca.

600-800 m [see Carleton & Schmidt, 1990]), near to Périnet (Andasibe).

DIAGNOSIS—Rhinarium very large, naked posterodorsal extension with transverse striae. Ears small, virtually concealed by the pelage. Skull pyriform, rostrum elongated, blunt anteriorly, braincase short.

DESCRIPTION—Moderately large (see Tables 19-1 and 19-3), tail shorter than head and body. Pelage soft, lustrous gray-brown dorsally, gray ventrally; dorsal hairs are three-banded, with light gray bases, light buff terminally, with bright brown tips; guard hairs dark brown or black; ventral hairs have light gray bases and brown tips. The feet are light-colored and the tail darker dorsally, grading into the paler ventral surface. Muzzle very long, forming a proboscis protruding anteriorly well beyond mouth; rhinarium very large, transversely striated naked region extends posterodorsally for ca. 6-7 mm (see Fig. 19-6). Eyes very small. Ears small, virtually concealed in the pelage, anterior border lies far behind eye when pressed forward against head. Forefeet broad, claws enlarged. Skull long, moderately gracile and pyriform in shape; the anterior part of the skull is elongated in appearance but the posterior interorbital and braincase region appear somewhat anteroposteriorly shortened (see Fig. 19-7). The rostrum is slender and elongated but not noticeably tapered, and the anterior is blunt and the nasals slightly flared anteriorly; the nasals extend posteriorly into the interorbital region; the premaxillae meet the nasals at a level between C and P2. The braincase is short and broad; the superior articular facets are rectangular and visible in dorsal view; the frontals and parietals are moderately small and the occipital moderately deep; the supraoccipital suture is dorsally positioned on the braincase. The palatine lip forms the anterior border of the pterygoid foramina. The mandible is sinuous, moderately elongated, and the mental foramen lies below p3. The dentition is moderately reduced, and long diastemata are present between all of the anterior teeth from I1 to P3 (see Fig. 19-8b). The first upper incisor is slightly proodont, with a well-developed distostyle approximately one-third the height of the principal cusp; I1 is larger than I2 and I3, and subequal to C; I2 is subequal in crown height to I3 but slightly less than C. The upper canine has a prominent distostyle and a small anterior accessory cusp. The first upper premolar (P2) is tricuspid; P3 is premolariform and resembles P4, with a small distinct mesostyle, an anterior ectostyle, distostyle, and a

posterolingual accessory cusp; the mesostyle is present on P4, the anterior ectostyle is distinct, the distostyle and posterior ectostyle are present, and the talon is well marked and bicuspid. The molars have narrow but well-marked talons (see Fig. 19-8c). The first lower incisor (i1) is procumbent with a distinct hypoconulid and a well-developed lingual cingulum. The lower canine has a prominent accessory cusp. The first lower premolar (p2) is tricuspid, taller than the canine, and with a robust principal cusp. Diastemata are present between all teeth from i2 to p3. The second lower premolar (p3) is similar to but larger than p2. The talonid of the third lower molar (m3) is slightly reduced; a talonid basin, hypoconid, hypoconulid, and entoconid ridge are present with a slight trace of an entoconid (see Fig. 19-8c).

DECIDUOUS DENTITION—Of the three immature specimens belonging to this species, one is an infant (FMNH 151812) in which M2 and m2 are partially erupted and M3 and m3 are just beginning to erupt; the other two are juveniles (FMNH 151650 and 151651) with fully erupted molars but a completely deciduous antemolar dentition. The deciduous dentition of this species (Fig. 19-9) shows similar traits to that of other species of *Microgale* (see MacPhee, 1987), except that the deciduous incisors and canines are only slightly smaller than the permanent teeth. The lower second deciduous incisor (di2) has a prominent lingual cingulum unlike i2, and the lower deciduous canine (dc) has a small anterior accessory cusp unlike the permanent lower canine.

MEASUREMENTS—External and cranial measurements are presented in Tables 19-3 and 19-4.

VARIATION—The pelage of the single specimen from Fanovana is harsher in texture than that of the RNI d'Andringitra specimens.

REPRODUCTION—All three of the adult females collected during the first half of December had large mammae; two specimens were lactating and one had three placental scars (one on left and two on right oviducts). Mammae formula: 2-0-4 (N = 2).

ETYMOLOGY—The name of this species is derived from the Greek *gymno*—naked, *rhynch*—snout or nose, and refers to the prominent, naked rhinarium.

COMPARISON WITH OTHER SPECIES—With the exception of *M. gracilis*, *M. gymnorhyncha* is readily distinguished from all other species of *Microgale* recorded from the RNI d'Andringitra by features including the long muzzle and elongated rhinarium, the small ears partially concealed in the

pelage, the broad forefeet with enlarged claws, and the elongated rostrum and short braincase characteristic of the skull.

Microgale gymnorhyncha is remarkably similar morphologically to *M. gracilis* and there are few differences in external appearance between the two species, which presumably share many adaptive features. *Microgale gracilis* is slightly larger than *M. gymnorhyncha* (see table 19-3), with a longer tail relative to the head and body. In both species the muzzle is prolonged into a flexible proboscis; both have a large rhinarium, but that of *M. gracilis* is smaller ventrally and the posterodorsal extension is shorter (4–5 mm long), with a reticulated anterior portion and incomplete striae on the posterior portion. The eyes of *M. gracilis* are similarly nearly concealed but are slightly larger than those of *M. gymnorhyncha*, and the ears are also slightly larger, only partially concealed by the pelage, just reaching the posterior border of the eye if pressed forward. Both have broad forefeet with enlarged claws, but the hind foot is shorter in *M. gymnorhyncha* than in *M. gracilis*. In contrast to *M. gymnorhyncha*, the skull of *M. gracilis* is even more gracile and elongated, with a slender, elongated, markedly attenuated rostrum and a longer interorbital region and braincase; the premaxillae meet the nasals above P2; the braincase is rounded and longer; the pterygoid foramina are partially or completely bridged by the palatine lip, which forms an incomplete or complete transverse bar. The mandible of *M. gracilis* is elongated and anteriorly tapering, and the mental foramen lies below p2 or anterior to p3. The dentition of *M. gracilis* is gracile and more reduced than that of *M. gymnorhyncha*, with extensive diastemata between all of the anterior teeth, so that the anterior portion is more elongated relative to the whole toothrow than in *M. gymnorhyncha* (see Table 19-3). In contrast to *M. gymnorhyncha*, the upper incisors in *M. gracilis* are subequal in height, the incisors and canine are very slender, and the diastema between P2 and P3 is much longer; a lingual cingulum may be present on P3, but there is no posterolingual accessory cusp; the talon on P4 is narrow; the talons on the molars are very reduced and resemble cingula; the lower canine lacks an accessory cusp; the talonid of m3 is more reduced and lacks an entoconid. There are few differences in the deciduous dentitions of the two species, except that a metaconid is present on the first deciduous lower premolar (dp2) and an accessory cuspid is present posterior to the metaconid on the second lower

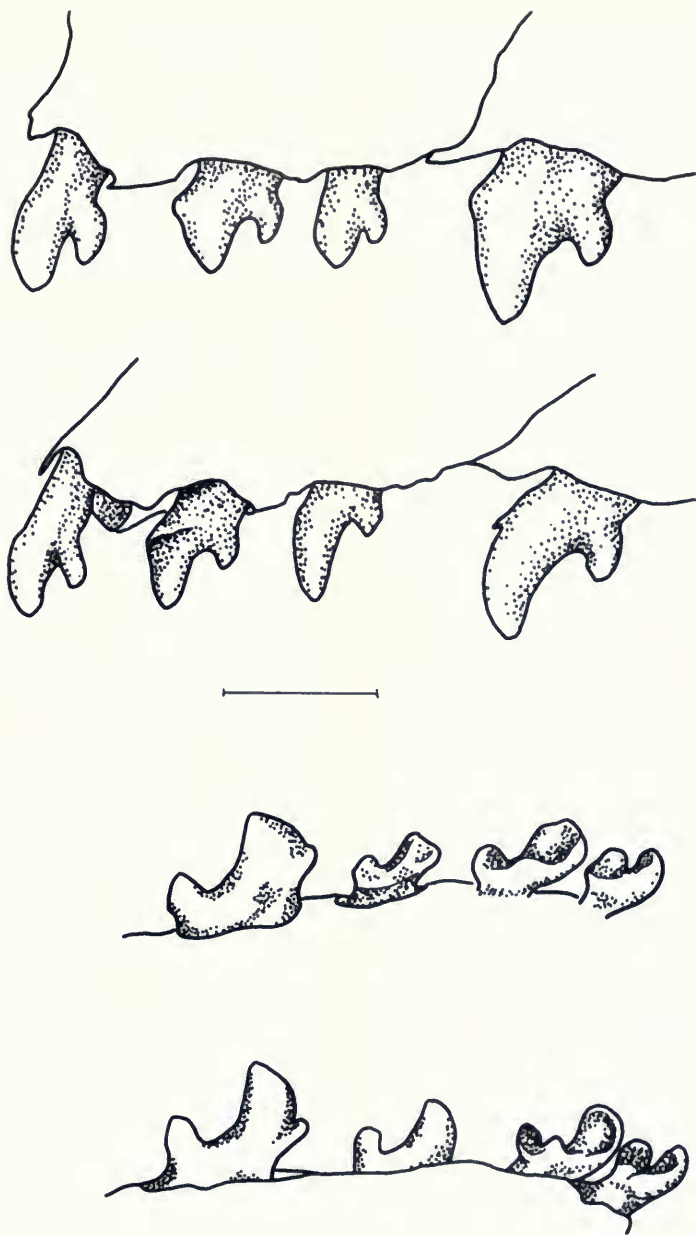


FIG. 19-9. **Top:** left anterior deciduous dentition of *M. gymnorhyncha* FMNH 151651 (above) and *M. gracilis* FMNH 151649 (below). **Bottom:** buccal view of upper dentition (above); lingual view of lower dentition (below). Scale 1 mm.

deciduous premolar (dp3) of *M. gracilis*, in contrast to *M. gymnorhyncha*, which lacks a metaconid on dp2 and shows no trace of an accessory cuspid on dp4 (although a metaconid is present on dp3, contra MacPhee [1987, p. 18], who stated that a metaconid on dp3 is usually absent in all species other than *M. parvula*).

Microgale gymnorhyncha is somewhat similar in external appearance to *M. thomasi* Major, 1896a, a species that has not been recorded from the RNI d'Andringitra but is known to occur in eastern Madagascar from Ivohimanitra (ca. 20°42'S 47°35'E) to Vondrozo (ca. 22°49'S 47°20'E) (see MacPhee, 1987). *Microgale tho-*

masi differs from *M. gymnorhyncha* in the following features: the muzzle is shorter, and although the rhinarium is moderately large, it does not extend posteriorly; the ears are obvious and the forefeet are not broadened, nor are the foreclaws enlarged. The skulls of both species are similar in size but differ in their proportions—that of *M. thomasi* is more robust. In contrast to that of *M. gymnorhyncha*, the rostrum of *M. thomasi* is moderately broad and short; the braincase is rounded, broader, longer, and deeper; the parietals are larger relative to the frontals and occipital; the pterygoid foramina open buccally into the posterior part of the palate; the mandible is robust and not sinuous, and the mental foramen lies below the posterior root of p2. The two species differ dentally: in *M. thomasi* the upper incisors and canine are not reduced, the diastemata between I1 and P3 are much smaller, P2 is larger, the lingual shelves on the upper molars are larger; p2 is very large, the talonid of m3 is similar, although the talonid basin is slightly broader.

REMARKS—Currently *M. gymnorhyncha* is known only from the localities listed above in the RNI d'Andringitra, Fianarantsoa Province, southern Madagascar and from Fanovana, central eastern Madagascar. All of the specimens from RNI d'Andringitra were trapped on slopes or ridges in montane forests at an altitude of 1210 m or in upper montane forest at 1625 m. No altitude was recorded for the specimen from Fanovana; it is estimated as 600–800 m based on the relief of the area.

No observations have been made on the behavior of this species. Although it is inadvisable to interpret morphological features in behavioral terms without direct observations, the combination of such features as the long muzzle with a large, naked rhinarium, the small eyes and partially concealed ears, and the broad forefeet with enlarged foreclaws suggests that this animal may use its forefeet and snout to rootle in the humus layer. The elongated rostrum and well-spaced teeth also suggest dietary specializations, although the identifiable gut contents of a single specimen included only arthropod fragments.

Microgale sp. A

REFERRED MATERIAL—FMNH 151646 and 151647: 40 km S Ambalavao, RNI d'Andringitra, along Volotsangana River, Fianarantsoa Province, 22°13'22"S 46°58'18"E, altitude 1210 m; BM(NH)

95.257: Basecamp 1, Maitso, RNI d'Andringitra, ca. 22°10'S, 46°50'E.

DESCRIPTION—In preparation (P.D.J. et al.).

MEASUREMENTS—External and cranial measurements of the specimens from RNI d'Andringitra are given in Table 19-1.

VARIATION—This species has been collected at several widely separated localities. Specimens from the RNI d'Andringitra population are larger on average than any of the other populations in external and cranial dimensions. In particular, the braincase of the RNI d'Andringitra specimens is broader and deeper than that of Parc National (PN) de la Montagne d'Ambre specimens. The two specimens from the PN de Ranomafana, although geographically closer to the RNI d'Andringitra specimens in southeastern Madagascar, are, however, more similar to the PN de la Montagne d'Ambre specimens in size, as is the single juvenile specimen from the Réserve Spéciale (RS) d'Ambatovaky.

REPRODUCTION—Both of the RNI d'Andringitra specimens collected in early December were pregnant females with permanent dentition. One individual (FMNH 151646) had three embryos (two left and one right) measuring 15 mm crown-rump length, and the other (FMNH 151647) had four embryos (two left and two right) measuring 17 mm crown-rump length. Mammary formula: 2-0-4 (N = 2).

Discussion

Although there is still doubt concerning the number of distinct species of *Microgale* occurring in Madagascar, the 10 species here recorded for RNI d'Andringitra form a high proportion of the 17 species currently recognized by us. Sympatric association between several species is a common phenomenon in the genus *Microgale*, and two to five species were recorded from half of the collecting localities mapped by MacPhee (1987). In areas that have been studied intensively, even greater numbers of species have been recorded. For example, six species were recorded from PN de la Montagne d'Ambre (Raxworthy & Nussbaum, 1994) and seven from RS d'Analamazaotra (Nicoll & Langrand, 1989). This high level of sympatry of RNI d'Andringitra is greater than that observed to date at any other locality, and although it certainly reveals the high diversity of the area, it may also reflect the thoroughness of

the inventory. The ecological implications of the speciosity of the area are discussed in Chapter 20.

Although MacPhee (1987) emphasized that the clusters he used to group species were a purely phenetic device, these clusters continue to be a very helpful method of associating species that share morphological features. The species occurring in the RNI d'Andringitra may be placed in these clusters, which are recorded below with a summary of the features shared by the included species:

cowani cluster—*Microgale cowani*, *M. taiva*, *M. melanorrhachis* (*M. parvula* less certainly associated)—craniodental similarities, foot proportions unmodified.

gracilis cluster—*M. gracilis*, *M. gymnorhyncha*—craniodental similarities, forefeet broad, foreclaws enlarged, rhinarium modified.

longicaudata cluster—*M. longicaudata*—craniodental characters, elongated hind feet, elongated tail.

dobsoni cluster—*M. dobsoni*—craniodental characters, foot proportions unmodified.

soricoides cluster—*M. soricoides*—craniodental characters.

pusilla cluster—not represented in the collections from RNI d'Andringitra.

brevicaudata cluster—not represented in the collections from RNI d'Andringitra.

Limited data on the annual reproductive cycle were provided for *M. dobsoni* and *M. talazaci* by Eisenberg and Gould (1970), both from trapping programs and from captive animals. More recently, Stephenson and Racey (1993) provided information on reproductive energetics in *M. talazaci* and *M. dobsoni*, as well as limited data on *M. cowani* and *M. melanorrhachis*. The data on reproductive condition for all 10 species collected at RNI d'Andringitra are presented in the preceding pages, and, although confined to the months of November and December when the trapping program was in operation, they provide a considerable increase of information over that previously available for the genus.

Some trends are evident within most species of *Microgale* found at the RNI d'Andringitra. On the basis of dentition, both adults and juveniles were found in most species, with the exception of *M. melanorrhachis* (juveniles only) and *M. dobsoni*, *M. soricoides*, and *Microgale* sp. A (adults only). On the basis of reproductive condition of the gonads, sexually adult animals of both sexes were

evident in *M. cowani*, *M. taiva*, and *M. longicaudata* only, but sexually adult animals of one sex were found in the other species. Species in which dental juveniles showed some signs of sexual maturity included *M. cowani*, *M. parvula*, and possibly also *M. melanorrhachis*, where individual females were perforate but showed no other evidence of sexual maturity, and *M. taiva*, in which an individual male had well-developed testes. Few conclusions may be drawn from these results, although there is evidence to suggest that dental juveniles may occasionally be recruited into the sexually adult population. Whether this indicates sexual precocity of juveniles or retardation of dental development into adulthood is impossible to decide from these limited data.

Dental development among juveniles of all species appeared to be at a fairly early stage, and there was no evidence of any development beyond Stage 1 to 2. This observation may coincide with the months of collection, November and December; these months are also at the beginning of the annual rainy season in eastern humid forest. The breeding season for this genus presumably starts earlier in the year, and it is probable that the presence of juveniles of this age is positively correlated with the start of the rainy season when food supplies should begin to increase. Individuals in which the molars were only partially erupted occurred in *M. cowani*, *M. taiva*, *M. longicaudata*, and *M. gymnorhyncha*. Individuals with fully erupted molars but completely deciduous antemolar teeth were found in *M. cowani*, *M. taiva*, *M. melanorrhachis*, *M. longicaudata*, *M. parvula*, and *M. gymnorhyncha*. Individuals showing Stage 1 to 2 states of development were found in *M. cowani*, *M. taiva*, and *M. gracilis*. It is probably significant that those species most commonly captured, *M. cowani* and *M. taiva*, also demonstrated the greatest range of variation in dental development of juveniles.

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University expedition, Louise Ashmore, Juliet O'Keefe, Matthew Thomas, and Oliver Tunstall Pedoe, made a small collection of specimens. For the opportunity to examine these species we thank them and, particularly, Nasolo Rakotoarison, Parc Botanique et Zoologique de Tsimbazaza for his cooperation in the loan of material. During this study the salary of C.J.R. was provided by a grant (BSR 90-24505) from the National Science Foundation. The photographs were prepared by Phillip Crabbe, Photographic Unit, BM(NH).

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Appendix 19-1.

Key to the Species of *Microgale* Occurring in RNI d'Andringitra

- Size very small: HB < 64, CIL < 16.6; TL subequal to HB 0.97-1.03; dark brown dorsal and ventral pelage*M. parvula*
Size larger: HB > 63, CIL > 17.3; pelage not dark brown dorsally and ventrally2
- Ratio of TL:HB 1.7-1.9; dorsal pelage reddish *M. longicaudata*
Ratio of TL:HB < 1.43
- Digits and tail tip contrastingly paler than body, tail, and feet*Microgale* sp. A.
Tail tip and digits not obviously paler than rest of body4
- Dorsal pelage with a distinct, dark mid-dorsal stripe extending from the head to the base of the tail; tail bicolored, dark brown above, lighter below *M. melanorrhachis*
No distinct mid-dorsal stripe5
- Size very large: HB > 108, CIL > 30.0; i2 ≫ c*M. dobsoni*
Size smaller: HB < 105, CIL < 30.0; i2 subequal or > c6
- Proboscis long, large rhinarium extends posterodorsally onto muzzle; forefeet broad, foreclaws enlarged7
Small rhinarium confined to anterior of short proboscis; forefeet slender without lengthened foreclaws8
- Posterior region of rhinarium with transverse striae; ratio of II-P3:UTL < 55.0; BL < 8.0
.....*M. gymnorhyncha*
Posterior region of rhinarium reticulated; ratio of II-P3:UTL > 57; BL > 8.4*M. gracilis*
- II robust, markedly proodont; i1 ≫ i2 > c; P2 and p2 very small with single roots *M. soricoides*
II neither robust nor markedly proodont; i1 < or subequal to i2; P2 and p2 with two roots9
- Ratio of TL:CIL 2.7-3.1; ratio of II-P3:UTL 52.8-56.4*M. cowani*
Ratio of TL:CIL 3.5-4.2; ratio of II-P3:UTL 49.1-52.8*M. taiva*